Marceline, Missouri
Water Supply Study

Marceline is located in Southeast Linn County in North Central Missouri.

Marceline has two lakes that can provide water to the city. They also have plans to pump from Mussel Fork Creek if needed.

Mussel Fork Creek intake location is East of Marceline and has a drainage of 146.71 square miles. The watershed shape is long and narrow, like many of North Missouri streams. Downstream of this location, at drainage area 267 square miles, is a stream gage site. Records were kept from October 1948 through September 1951 and again Oct 1962 through February 1990. For the 1950's, it was necessary to use the Locust Creek gage. Gage data was adjusted to the intake point by the drainage area ratio. Analysis of the data indicates that flow in Mussel Fork at the intake location would be so low during drought periods that withdraw would probably not be possible. Pumping was not considered part of this operation plan.

The 7-day Q-10 low flow needed to meet in-stream flow requirements is near zero.

A frequency analysis prepared to determine mean monthly discharges at the intake shows the 100 year(1%), 50 year(2%), and 25 year(4%) chance of non-excedence. These low flows are shown in figure 7. Low flows are 1 cubic feet per second or less for about half of the months.

The main lake is located approximately 4 miles SSW of Marceline and has a drainage area of 3.73 square miles. The surface area at the top of the dam is approximately 189 acres.

The older North Lake is used only if the water supply becomes critical. This North Lake has a drainage Area of 271 Acres. The lake has approximately 80 acres surface area at top of dam elevation. This lake was not surveyed. Storage-Area relationships were proportioned based on the main larger lake. The lake was assumed to be 18 feet deep when full.

Average annual rainfall for the last 50 years is 38.8 inches at Brookfield.
Annual rainfall during the drought period 1953 through 1957 was 7.6, 38.7, 34.1, 23.4, and 48.2 inches.

Marceline used 447,726 gallon per day in year 2000.
Optimum demand for the main lake is 412,000 gallon per day.
The old lake could be expected to supply 60,000 gallon per day.

Following is the data derivation by control word for use in the "RESOP" computer program.

STO-AREA Elevation-Storage and Elevation-Area data were determined from May 19, 2000 survey made by USGS.

Marceline City Lake (New)

Elevation (feet)	Area (acres)	Storage (ac-ft)
729.0	0	0
730.0	5	3
732.0	13	20
734.0	21	55
736.0	31	106
738.0	41	178
740.0	53	272
742.0	64	389

Old Lake (North) not surveyed

Assumed	Estimated	
Elev.	Area(Ac)	Volume(ac.Ft.)
100	0.0	0.0
100.5	2.1	0.6
101.6	5.5	4.8
102.7	8.9	12.7
103.8	13.1	24.7
104.9	17.4	41.4
106.0	22.4	63.3
107.1	27.1	90.4

744.0	75	528	108.2	31.7	122.7	
746.0	85	688	109.3	36.0	159.8	
748.0	97	870	110.4	41.1	202.1	
750.0	110	1080	111.5	46.6	250.1	
752.0	122	1310	112.6	51.6	304.0	
754.0	135	1570	113.7	57.1	363.6	
754.5	139	1630	114.0	58.8	379.5	
756.0	151	1850	114.8	63.9	40.0	
756.9	160	1990	115.3	67.7	462.5	Assumed Spillway
760	189		117.0	80.0	588.1	

Water surface 7/12/03 = 754.5 feet
Spillway Elevation = 756.9 feet

LIMITS	Marceline City Lake (New)	Max. pool storage	1990 Ac.Ft.
		Minimum pool storage	200 Ac.Ft.
	Old (North) Lake	Max pool storage	462 Ac.Ft.
		Minimum pool storage	60 Ac.Ft.

GENERAL The adjustment factor of 0.76 to convert from pan evaporation to lake evaporation was applied prior to entering the data for the control word EVAP. As a result a factor of 100 is applied.

The record period of drought is in the 1950's, analysis began in January 1951 and ended December 1959.

SEEPAGE The reservoir seepage varied from 0 seepage near empty to a maximum of 3.0 inch per month, per surface area when lake is full. The material in the dam is compacted earth of clayey soils.

RAINFALL Rainfall data came from the Brookfield, Missouri. rain gage.

RUNOFF This is the runoff into the lake from its drainage area. Monthly runoff volumes in watershed inches was determined at the Linneus gage on Locust creek and adjusted based on drainage area. When runoff did not appear reasonable when compared to rainfall it was necessary to examine daily rainfall values for that month. Antecedent moisture was estimated for each rainfall event and adjustments to NRCS runoff curve number was made to arrive at runoff for each storm.

EVAP. -- Pan evaporation at the Lakeside gaging station was used as a base because it has some data for year around evaporation. This data was updated with gage data from stations at Spickard, New Franklin, and Columbia. Depending on the latest data for the station nearest to Marceline.

DEMAND -- This was determined by city records. They used 447,726 gallons per day in year 2000. Only an optimized run was made for the old lake.

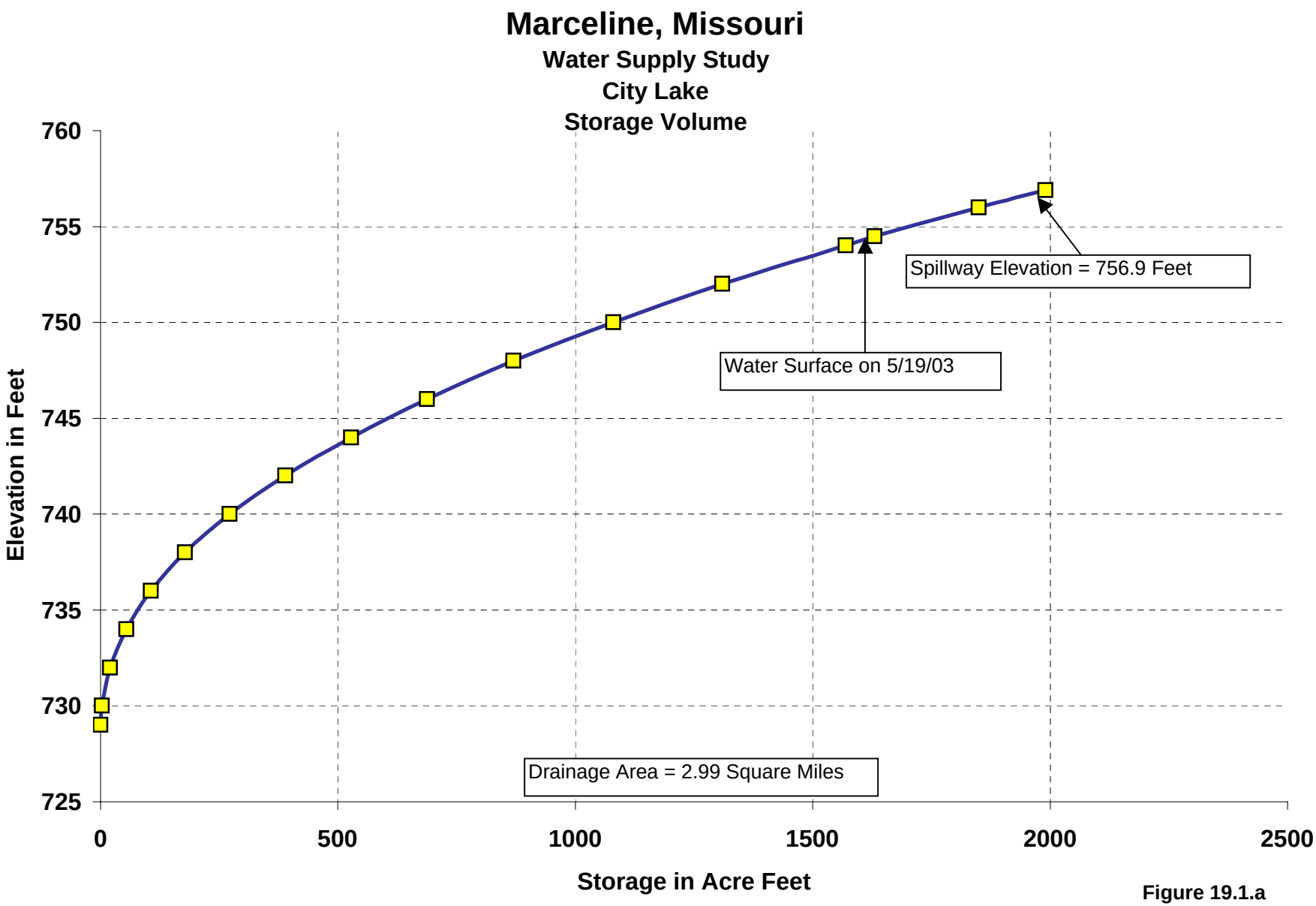

Marceline, Missouri
Water Supply Study
City Lake
Storage Volume
760
755
750
745
740
735
730
725
Elevation in Feet
0
500
1000
1500
2000
2500
Storage in Acre Feet
Spillway Elevation = 756.9 Feet
Water Surface on 5/19/03
Drainage Area = 2.99 Square Miles

Figure 19.1.a

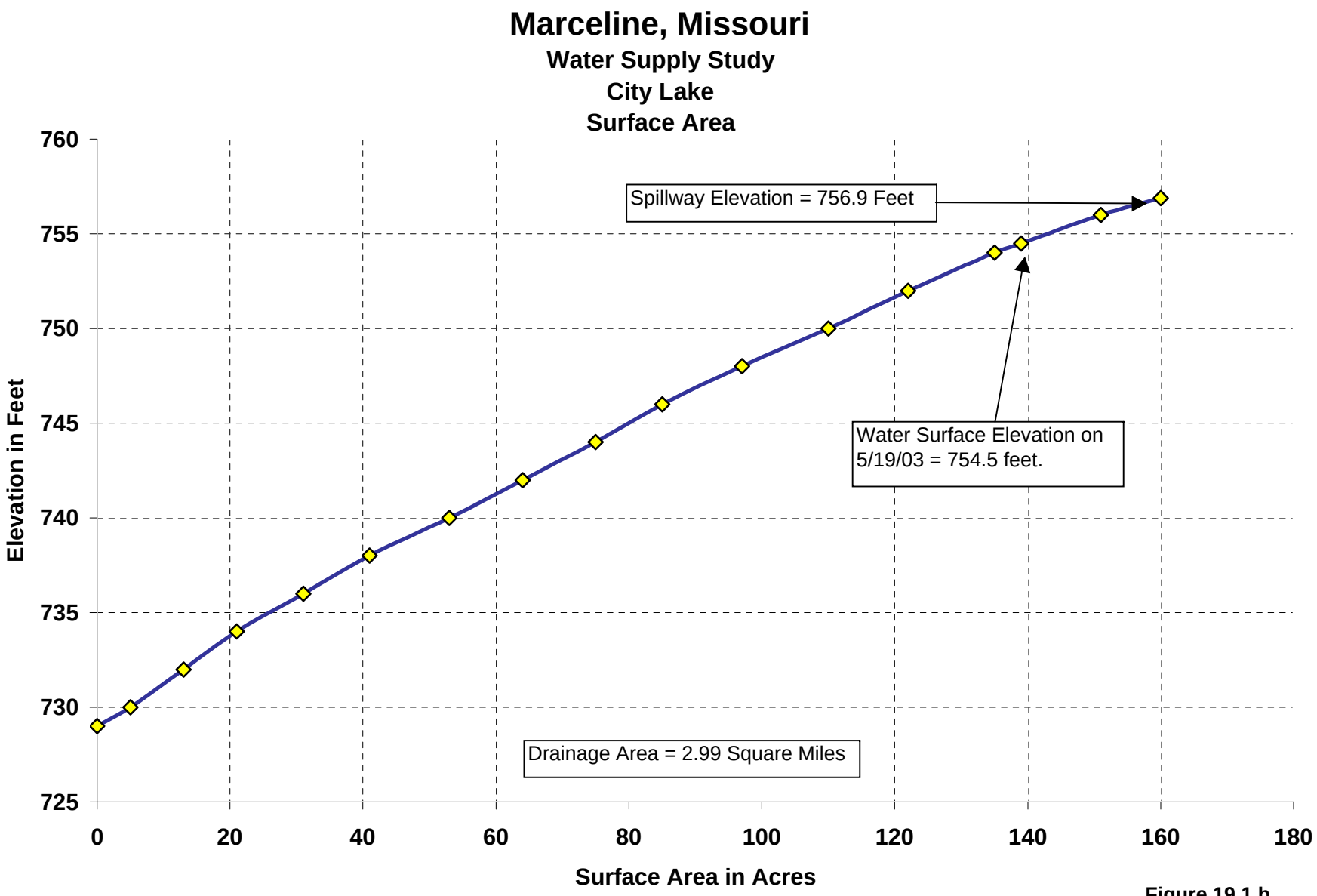

Marceline, Missouri
Water Supply Study
City Lake
Surface Area
Elevation in Feet
760
755
750
745
740
735
730
725
0
20
40
60
80
100
120
140
160
180
Surface Area in Acres
Spillway Elevation = 756.9 Feet
Water Surface Elevation on 5/19/03 = 754.5 feet.
Drainage Area = 2.99 Square Miles

Figure 19.1.b

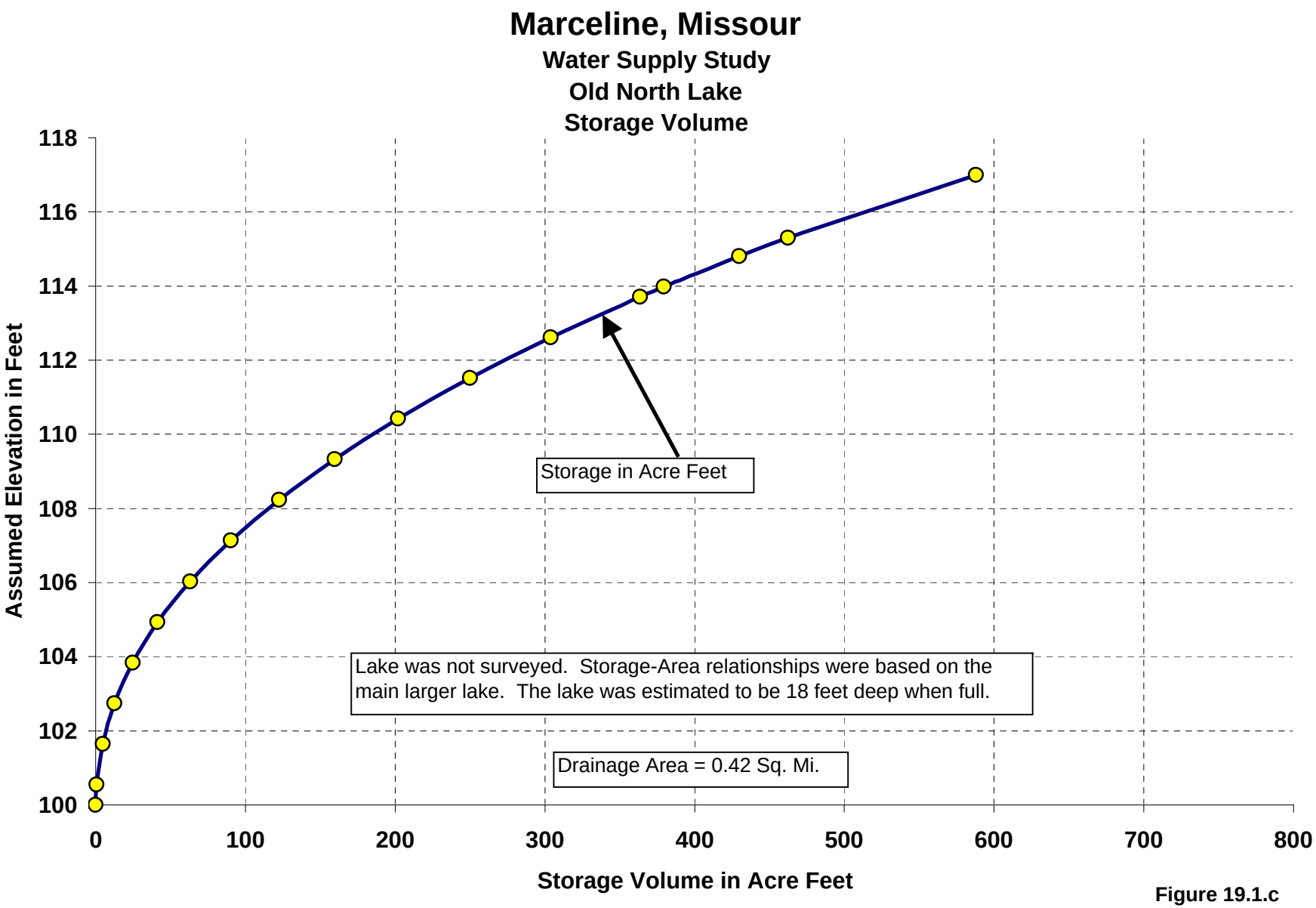

Marceline, Missour
Water Supply Study
Old North Lake
Storage Volume
Assumed Elevation in Feet
118
116
114
112
110
108
106
104
102
100
0
100
200
300
400
500
600
700
800
Storage Volume in Acre Feet
Storage in Acre Feet
Lake was not surveyed. Storage-Area relationships were based on the main larger lake. The lake was estimated to be 18 feet deep when full.
Drainage Area = 0.42 Sq. Mi.

Figure 19.1.c

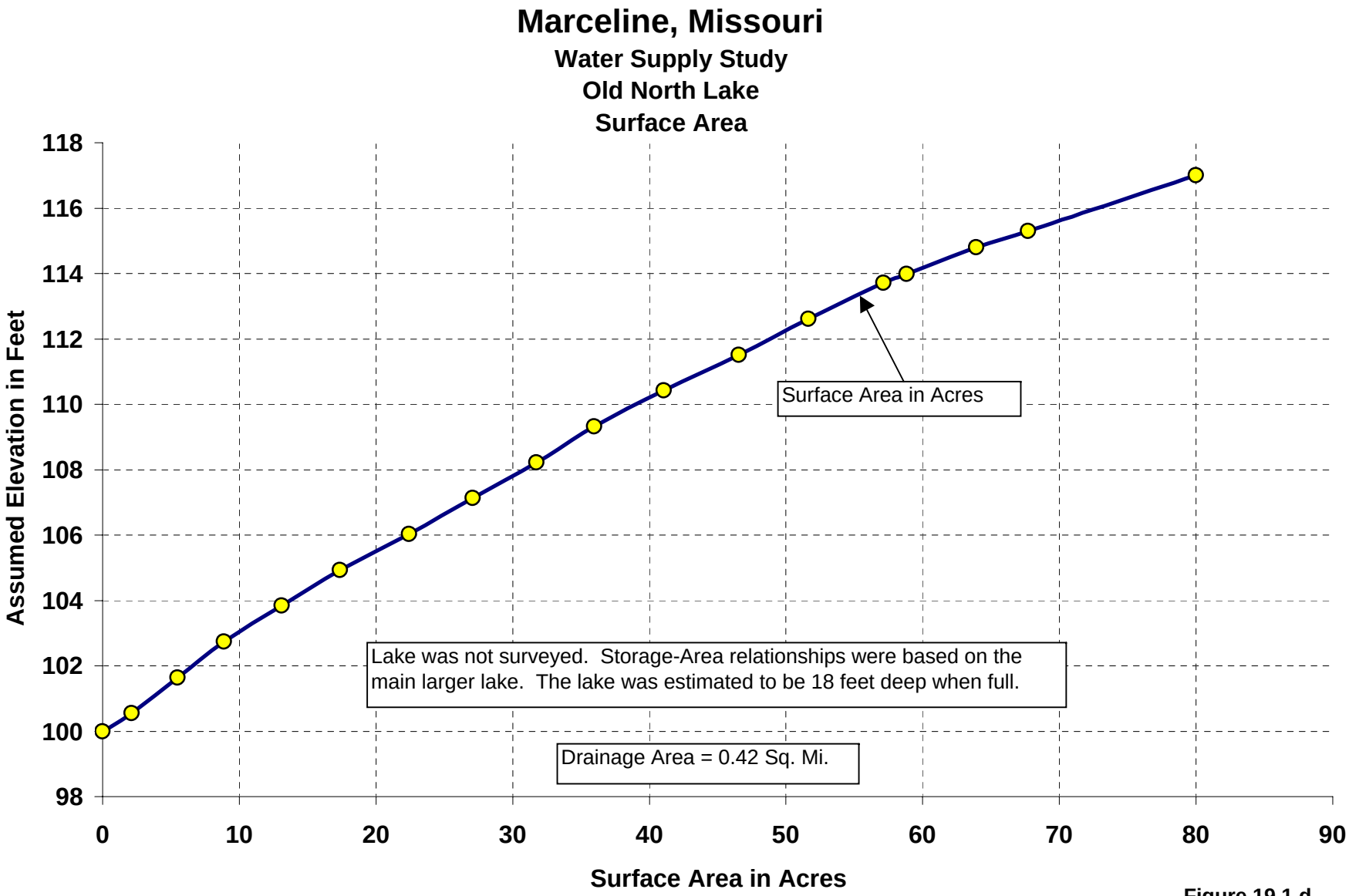

Marceline, Missouri
Water Supply Study
Old North Lake
Surface Area
Assumed Elevation in Feet
118
116
114
112
110
108
106
104
102
100
98
0
10
20
30
40
50
60
70
80
90
Surface Area in Acres
Surface Area in Acres
Lake was not surveyed. Storage-Area relationships were based on the main larger lake. The lake was estimated to be 18 feet deep when full.
Drainage Area = 0.42 Sq. Mi.

Figure 19.1.d

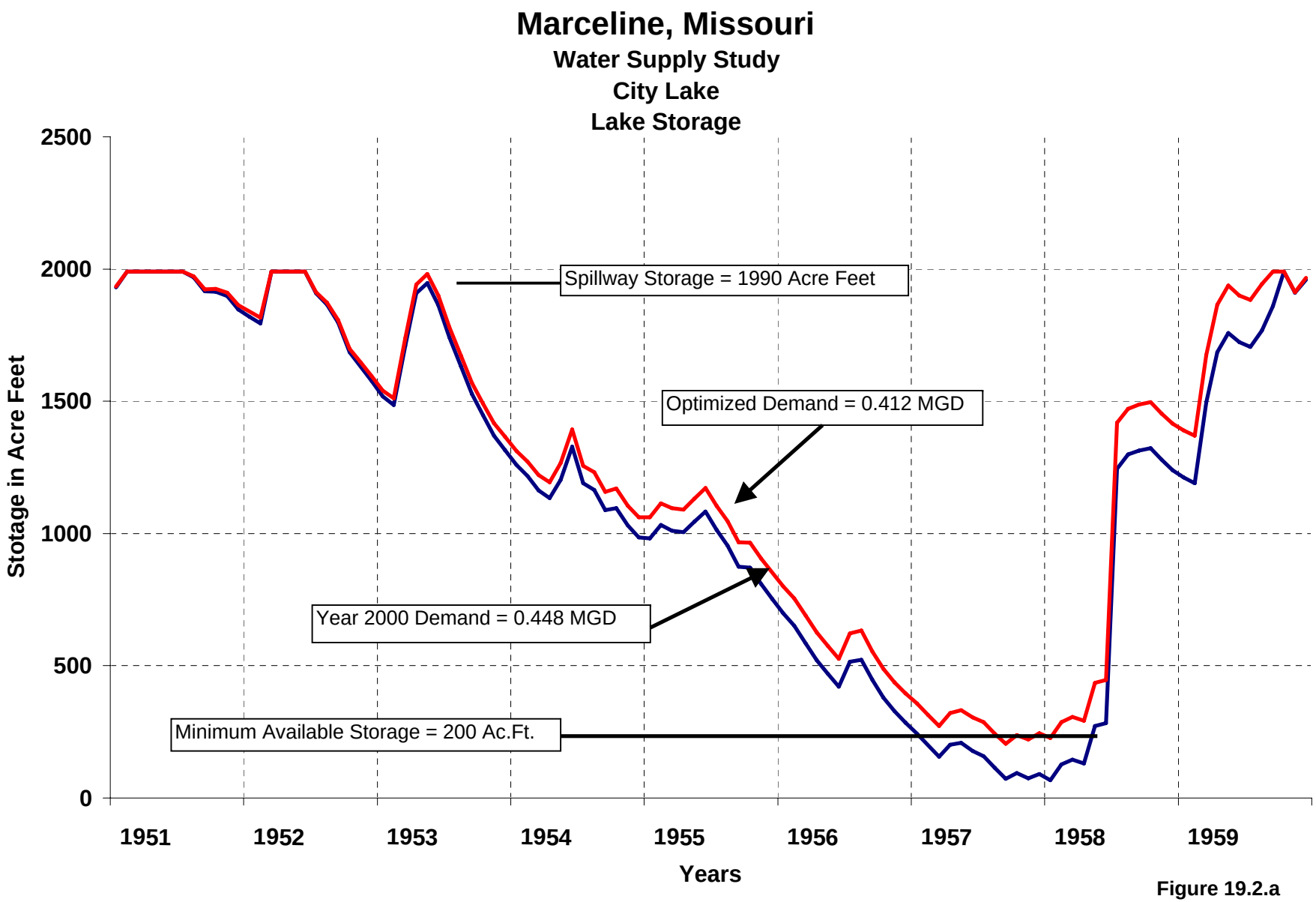

Marceline, Missouri
Water Supply Study
City Lake
Lake Storage
Stotage in Acre Feet
2500
2000
1500
1000
500
0
1951
1952
1953
1954
1955
1956
1957
1958
1959
Years
Spillway Storage = 1990 Acre Feet
Optimized Demand = 0.412 MGD
Year 2000 Demand = 0.448 MGD
Minimum Available Storage = 200 Ac.Ft.

Figure 19.2.a

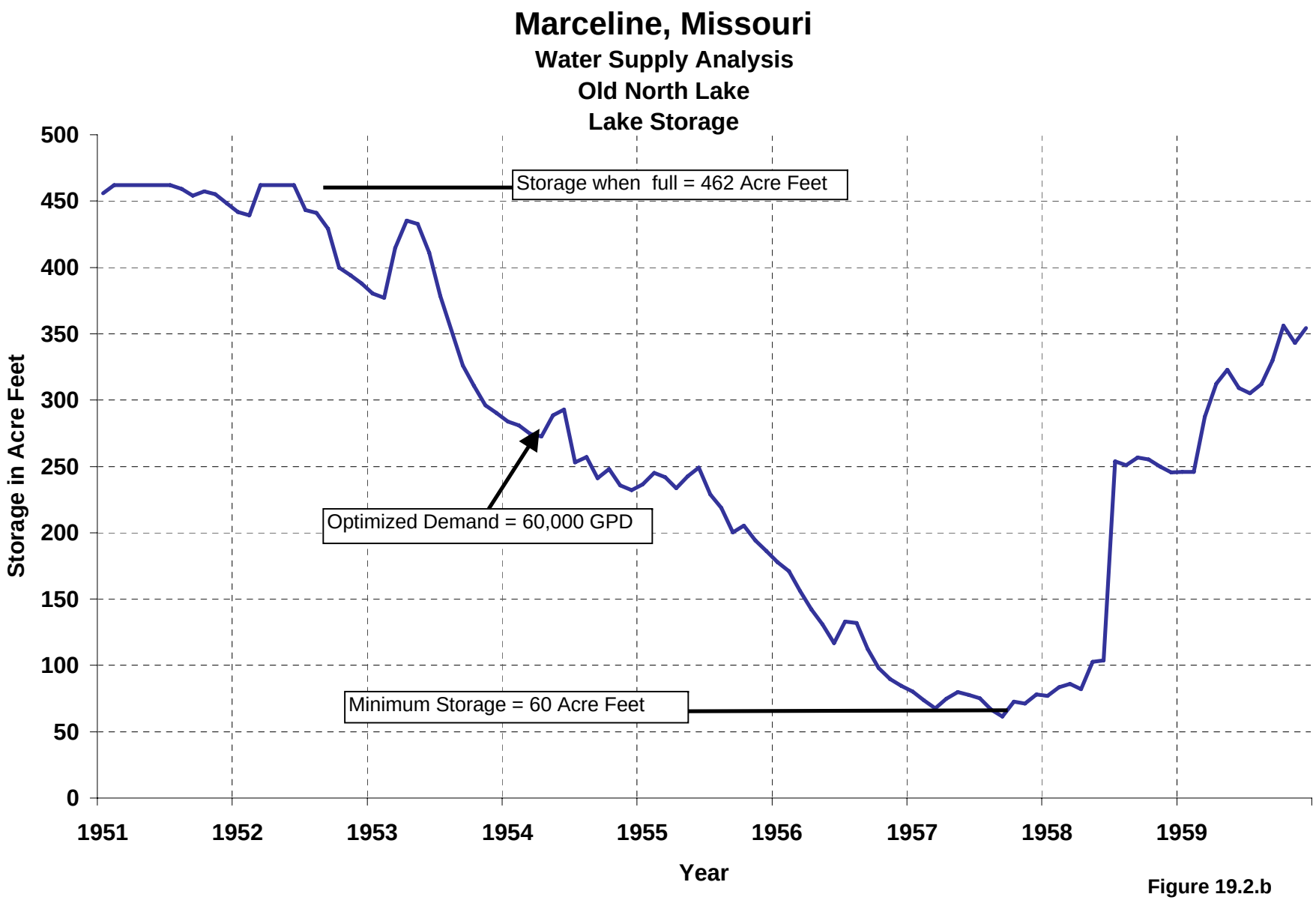

Marceline, Missouri
Water Supply Analysis
Old North Lake
Lake Storage
Storage when full = 462 Acre Feet
Optimized Demand = 60,000 GPD
Minimum Storage = 60 Acre Feet
Storage in Acre Feet
500
450
400
350
300
250
200
150
100
50
0
1951
1952
1953
1954
1955
1956
1957
1958
1959
Year

Figure 19.2.b

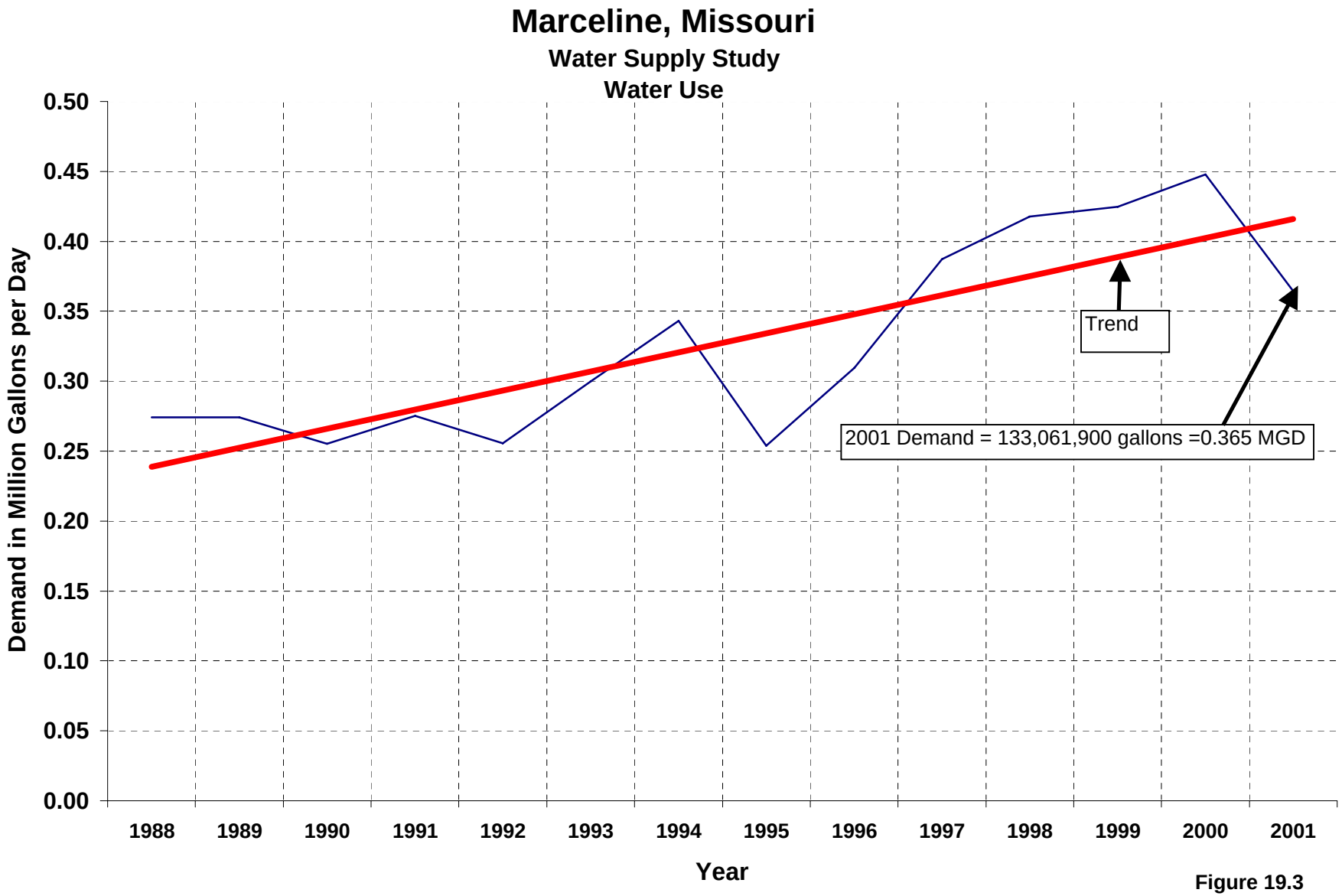
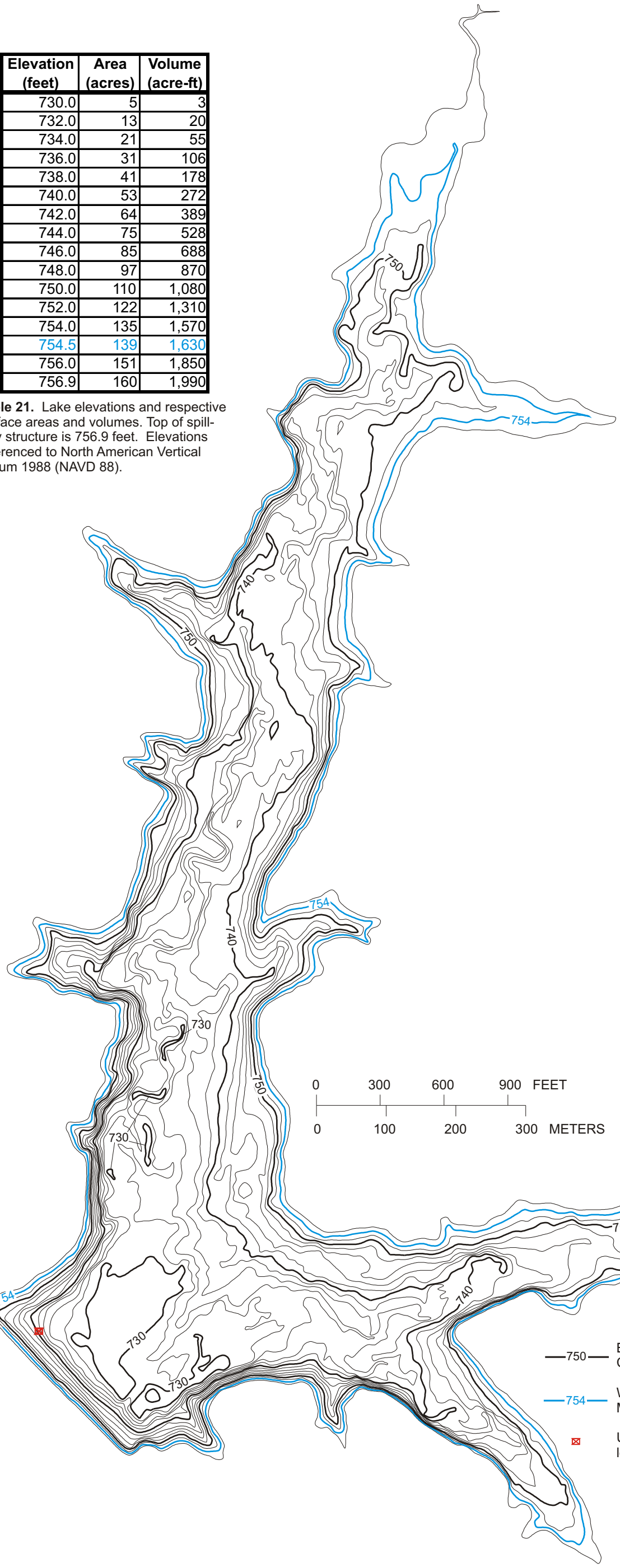

Marceline, Missouri
Water Supply Study
Water Use
Demand in Million Gallons per Day
0.50
0.45
0.40
0.35
0.30
0.25
0.20
0.15
0.10
0.05
0.00
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
Year
Trend
2001 Demand = 133,061,900 gallons =0.365 MGD

Figure 19.3

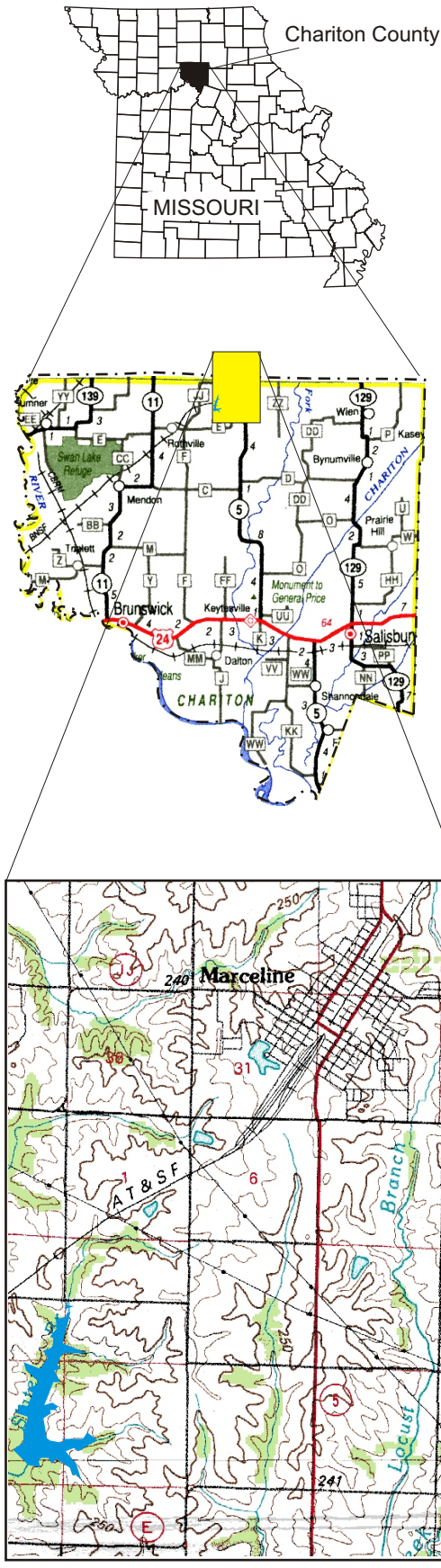
MARCELINE LAKE

Elevation (feet)	Area (acres)	Volume (acre-ft)
730.0	5	3
732.0	13	20
734.0	21	55
736.0	31	106
738.0	41	178
740.0	53	272
742.0	64	389
744.0	75	528
746.0	85	688
748.0	97	870
750.0	110	1,080
752.0	122	1,310
754.0	135	1,570
754.5	139	1,630
756.0	151	1,850
756.9	160	1,990

Table 21. Lake elevations and respective surface areas and volumes. Top of spillway structure is 756.9 feet. Elevations referenced to North American Vertical Datum 1988 (NAVD 88).



LOCATION MAP



EXPLANATION

750 — BATHYMETRIC CONTOUR—Shows altitude of the reservoir bottom. Contour interval 2 feet.

754 — WATER SURFACE—Shows approximate elevation of water surface, May 19, 2003 (actual is 754.5 feet, table 21).

U. S. GEOLOGICAL SURVEY REFERENCE MARKER—Chiseled arrow located on northwest side of intake tower. Elevation 764.1 feet.

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Figure 19.4 Bathymetric map and table of areas/volumes of the Marceline Lake (New) near Marceline, Missouri.

In cooperation with Missouri Department of Natural Resources